Legislative Audit Division

State of Montana

Report to the Legislature

September 2001   **Performance Audit**

Geographic Information System (GIS) Implementation and Development in Montana

Federal, State, Local and Private Sector Entities

The report contains information about GIS in Montana. Various GIS groups are responsible for coordination and oversight activities. This report provides background information and recommends areas for improvement regarding coordination and administration of GIS activities in the state.

Direct comments/inquiries to:
Legislative Audit Division
Room 160, State Capitol
PO Box 201705

01P-07   Helena MT 59620-1705

Help eliminate fraud, waste, and abuse in state government. Call the Fraud Hotline at 1-800-222-4446 statewide or 444-4446 in Helena.

PERFORMANCE AUDITS

Performance audits conducted by the Legislative Audit Division are designed to assess state government operations. From the audit work, a determination is made as to whether agencies and programs are accomplishing their purposes, and whether they can do so with greater efficiency and economy. The audit work is conducted in accordance with audit standards set forth by the United States General Accounting Office.

Members of the performance audit staff hold degrees in disciplines appropriate to the audit process. Areas of expertise include business and public administration, statistics, economics, accounting, logistics, computer science, and engineering.

Performance audits are performed at the request of the Legislative Audit Committee which is a bicameral and bipartisan standing committee of the Montana Legislature. The committee consists of six members of the Senate and six members of the House of Representatives.

MEMBERS OF THE LEGISLATIVE AUDIT COMMITTEE

Senator John Cobb	Representative Joe Balyeat
Senator Jim Elliott	Representative Dee Brown
Senator Dan Harrington	Representative Bill Eggers
Senator Ken Miller	Representative Hal Jacobson
Senator Corey Stapleton	Representative Jeff Pattison, Vice Chair
Senator Jon Tester, Chair	Representative David Wanzenried

Scott A. Seacat, Legislative Auditor
John W. Northey, Legal Counsel

Deputy Legislative Auditors:
Jim Pellegrini, Performance Audit
Tori Hunthausen, IS Audit & Operations
James Gillett, Financial-Compliance Audit

September 2001

The Legislative Audit Committee
Of the Montana State Legislature:

We conducted a performance audit of Geographic Information System (GIS) implementation and development in Montana. No single state agency or entity is responsible for monitoring or managing GIS use or application in the state. Our audit focused on the activities of four groups established to coordinate GIS development to assure standardization thereby minimizing duplication and encouraging cost-sharing. We examined the process used by the groups to communicate and achieve consensus to coordinate development activities.

We appreciate the cooperation and assistance provided by members of the Montana Geographic Information Council, Interagency Technical Working Group, Montana GIS Users' Group, and Montana Local Government GIS Coalition.

Respectfully submitted,

(Signature on File)

Scott A. Seacat
Legislative Auditor

Legislative Audit Division

Performance Audit

Geographic Information System (GIS) Implementation and Development in Montana

Federal, State, Local and Private Sector Entities

Table of Contents

Table of Contents

List of Figures and Tables

Appointed and Administrative Officials

Judy Martz, Governor

Barbara Ranf, Chair, Montana Geographic Information Council

Kathie Jewell, Chair, Montana GIS Interagency Technical Working Group

Ed Madej, President, Montana GIS Users' Group

R.J. Zimmer, Chair, Montana Local Government GIS Coalition

Introduction

The Legislative Audit Committee requested a performance audit of Geographic Information System (GIS) implementation and development. GIS is an information technology that allows data to be integrated based on geographic features. No single state or local entity is responsible for monitoring or managing GIS use or application within the state. The Montana Geographic Information Council (Council), created by executive order of the Governor in 1997, was established to provide policy level direction. Additionally, GIS users formed coordinating groups to facilitate development within state and local government, as well as the private sector.

What is GIS?

A geographic information system is a computer-based tool for mapping a wide variety of information. The technology integrates database information with the visualization offered by maps. GIS software provides the tools needed to store, analyze, and visually display information. GIS stores and manages information as a collection of layers linked together through geographic references. One of the goals of GIS is to eliminate redundant data collection and usage. The principle is that data should be collected once and then accessed by all who need it (efficiency). Effectiveness benefits stem from creating a capability to complete tasks that were not routinely done because of their size, cost, or complexity. With GIS, major data projects can be updated regularly and used for routine decision-making. Any data element that includes a location reference has potential for GIS application. The level of detail in geographic references can be as general as a city, county, or zip code, or as specific as land parcel or global positioning system point references.

Framework Data Layers are the Foundation

The federal government, in cooperation with state, regional, local, and private sector interests has identified seven framework data layers for the nation. Framework layers follow themes identifying geographic features or characteristics, relating to national, state, or regional interests and needs. Geographic features may be either natural or manmade. The development of framework layers provides several benefits. Layers are usually available to users at no or minimal cost. Once a layer is developed, other groups do not have to

develop their own base layer. Layers also represent the primary spatial or geographical themes, and can be overlaid upon each other to provide varying levels of detail. These layers are:

▸ Elevation and bathymetry (elevation of land and depths of bodies of water).

▸ Hydrography (surface water features such as rivers, lakes, and streams).

▸ Geodetic control (a set of known positions with precisely determined locations from which other locations can be referenced).

▸ Cadastral or land parcel (rights associated with land, such as ownership).

▸ Transportation (features used to move people and goods, including roads, bridges, tunnels, rail lines, and similar features).

▸ Government units (boundaries of entities such as cities, counties, or reservations).

▸ Orthoimagery (aerial photographs or satellite imagery).

In addition to federally established layers, states or local government entities can develop additional framework layers to meet specific needs. Montana's GIS community identified four additional layers:

▸ Geology (surface features).
▸ Hydrologic units (sub-watersheds and drainages).
▸ Land cover (vegetation).
▸ Soils (inventory and classifications).

Montana GIS Clearinghouses

Clearinghouses provide access to, and information about, GIS data similar to a library providing access to other documentation. Although the general purposes of clearinghouses are similar, most focus on specific types of data or reflect regional interests. As a result, there are a number of clearinghouses in Montana. As part of their library function, clearinghouses often provide referral services and Internet links to other clearinghouses. The Montana Natural

Resource Information System (NRIS) is generally considered the primary clearinghouse in the state. The 1985 Legislature created NRIS to be a repository for natural resource information such as geographic features and water resources. NRIS is part of the Montana State Library. Its mission is to provide Montana citizens with comprehensive and accurate information essential to managing natural resources.

Another prominent clearinghouse is the Department of Commerce, Census and Economic Information Center (CEIC). The center is designated by the U.S. Census Bureau as the State Data Center and Business/Industry Data Center for Montana. The CEIC offers a variety of mapping, geographic, and GIS data resources and services related to census and business data.

Four Coordinating Groups

The Environmental Protection Agency (EPA) and private companies involved in Superfund site activities funded early GIS development in the state. The majority of Montana's initial GIS users were associated with natural resource organizations involved with the EPA and Superfund site activities. To facilitate GIS development, users established groups to coordinate sharing of data and resources and the development of data standards. During the audit, we identified four organizations that have assumed primary responsibility for developing and coordinating GIS activities:

‣ Montana GIS Interagency Technical Working Group (Technical Group)

‣ Montana Local Government GIS Coalition (Local Coalition)

‣ Montana GIS Users' Group (Users' Group)

‣ Montana Geographic Information Council (Council)

Communication and Cooperation

Cooperation and collaboration are fundamental to the development of GIS capabilities, because success relies upon the establishment of large data bases used by entities at all levels throughout the public and private sectors. The development of framework data layers is necessary in order to provide foundations upon which more entity-specific data can be applied and used for decision-making.

Report Summary

Development crosses many government and private sector jurisdictions. Frequently, development also means the integration of multi-discipline data. As a result, a project advocacy approach has evolved in Montana. While the Council is often viewed as the focal point for GIS advocacy, we found all four of the primary coordinating groups routinely serve in an advocacy capacity. We believe the level of communication and coordination is achieved because the majority of the participants in all of these organizations are active GIS participants. GIS development to date in Montana has been effective as a direct result of the participants' strong commitment to communication and coordination.

Duplication and Cost-Sharing

Data development is the most significant cost factor for most GIS projects. For other governmental information technology systems, hardware and software frequently generate the majority of the cost. For GIS, reducing data duplication and maximizing cost-sharing are important aspects of the development process. We found all four coordinating groups support the concept that agencies with common interests and mutual information needs should share in development and data collection efforts.

Conclusion:
GIS Development has been Effective

We conclude the existing organizations and oversight processes effectively use communication and coordination to develop GIS capabilities. Montana has benefited by using the spirit of cooperation approach to focus on specific projects and encourage the use of GIS. Further, the cooperative relationships between the Council, Technical Group, Local Coalition, and Users Group help to minimize duplication and increase cost sharing.

Planning

We noted the Council and the Technical Group routinely receive updates on the development of framework layers. However, project status is not compared to planning projections or milestones because in most cases they have not been formally developed. Recently, the Council and the Technical Group endorsed a planning approach proposed by the Federal Geographic Data Committee to assure consistency between states. As a result, Technical Group members developed plan abstracts for Montana's eleven framework layers. We believe the development of these abstracts is a good approach. It

is important for the Council to establish long-term goals for this process to assure continuing progress.

Conclusion:
Council Focus on Planning Should Improve Effectiveness

Increasing state and local agency participation, increasing access to training, timely designation of custodians, and improving the standardization process are all activities which could be enhanced with more focus on formal planning. Council members would have a better opportunity to compare project status, already provided on a routine basis, to established project goals, priorities, and milestones. Future GIS development will continue to require significant inter-jurisdictional cooperation and agreements. We believe the Council's role as a facilitator in this process is important. We recommend the Council establish a framework layer project planning review process to include review of:

- ▸ _Project cost, funding sources, and milestones._
- ▸ _Entity participation and training needs._
- ▸ _Data custodianship._
- ▸ _Standardization needs._

Issue Resolution

The GIS community involves all levels of government and the private sector. Progress and growth relies on cooperation and communication among all of the participants/groups. In this environment, where an agency must rely on outside entities, difficult decisions must be made to assure the overall effort stays on track. Sometimes these decisions will result in an outcome that may not appear to be in the best interest of a particular agency. However, the decision benefits the GIS community as a whole. We believe developing recommendations, which lead to a decision, is one of the roles of the Council. In our interviews with GIS participants, we were told of long standing issues that were viewed as not being resolved. We noted these issues were frequently discussed at Council or working group meetings. What seemed to be missing was the step that concluded with a Council position. The Council did not clearly communicate consensus on the issue, provide a formal resolution to the GIS community at large, or make a

recommendation to the governor or legislature if warranted. In GIS development, just as for the development of any management tool, issues arise which if not resolved, can cause duplication of effort and process inefficiencies.

Conclusion:
Pro-Active Management is Needed

We believe the Council should assume a more pro-active role regarding resolution of issues. GIS development is a process of technological innovation providing opportunities for growth and change and requires active management. A more active management approach could revitalize the issue oriented model. At one extreme, Council proposals for resolution might be no more than a policy statement reflecting consensus. At the other extreme, the Council could make a recommendation to the governor or the legislature to revise existing state law. However, for the GIS community, we believe the most important step to resolution is formalizing the Council's position. We recommend the Council develop procedures for resolving issues within the GIS Community by:

▶ *Establishing clear milestones and deadlines.*

▶ *Documenting Council consensus or resolution.*

▶ *Developing formal recommendations for the governor and/or legislature if necessary.*

Administrative Support

The executive order assigns the responsibility of providing administrative support for the Council to the Department of Administration. The department established a half-time GIS coordinator position to provide direct support to the Council and serve as the state GIS coordinator. In addition, another DofA staff member provides GIS information technology support to state agencies. In this report, we make recommendations for the Council to increase planning efforts and more actively manage and resolve issues of concern. More emphasis in both of these areas will require additional administrative support for the Council.

Current Resources are a Limiting Factor

Council members have limited time to dedicate to GIS activities because of their primary department, program, or business

responsibilities. The Council relies on the part-time coordinator to assist the chair and members with meeting agendas and minutes. The coordinator is also involved with federal agencies and national organizations representing Montana. In addition, the coordinator works with other state GIS groups to organize meetings and help prepare grant/funding justification. Depending on availability of the coordinator, we noted Council members routinely assist with meeting and agenda organization.

To date the implementation of GIS across Montana has been successful because of the willingness of the active participants to dedicate time and energy to Council business. In many instances this has required members to place GIS activities above their primary duties and responsibilities. For the Council to implement our recommendations, it needs help to review project status and conduct thorough planning. Similarly, in order to more actively resolve issues impacting GIS development, the Council will require help to identify priorities, document progress, and formalize positions.

Additional Resources

The primary need appears to be additional administrative support to assure Council members are aware of project status and issue priorities. This requires tracking planning documentation, monitoring working group deliberations, recording meeting activities, and formalizing consensus/resolution. In addition, coordinating the development of major data sets between entities could become a significant workload. The Council could also examine the need for an overall state implementation plan similar to those we noted were developed by other states. Further, the Council could consider preparing an annual assessment report for the governor and legislature to provide an overall status of planning and progress, identify funding requirements/priorities, or request assistance in resolving issues. Without additional resources, the Council could not undertake these kinds of efforts.

Conclusion:
Council Resource
Recommendation is Needed

We believe identification of the requirement for resources to meet the needs of the Council and statewide GIS coordinator activities is a Council responsibility. The Governor's executive order establishes the importance of coordinating efforts at all levels in order to

minimize duplication and take advantage of cost sharing. While the order endorses an "aggressive policy," the level of aggressiveness is clearly left to the Council to determine. We recommend the Council:

‣ *Determine the amount of administrative support required to improve planning, resolve issues, and provide an overall GIS implementation status.*

‣ *Evaluate alternatives for resource allocation.*

‣ *Prepare a recommendation to the Governor to address resources.*

Chapter I - Introduction

Introduction

The Legislative Audit Committee requested a performance audit of Geographic Information System (GIS) implementation and development. GIS is an information technology that allows data to be integrated based on geographic features. No single state or local entity is responsible for monitoring or managing GIS use or application within the state. The Montana Geographic Information Council (Council), created by executive order of the Governor in 1997, was established to provide policy level direction and promote efficient and effective use of resources. Additionally, GIS users formed coordinating groups to facilitate development within state and local government, as well as the private sector.

We examined the roles of the primary groups facilitating GIS implementation across the state. Our audit work focused on the processes used by these groups to communicate and achieve consensus to coordinate GIS development activities.

Audit Objectives

We developed three objectives:

1. Does the communication and coordination process assure an effective GIS development process?

2. Do review and decision-making processes assure data standardization thereby minimizing duplication and encouraging cost-sharing?

3. Are roles and responsibilities appropriately designated?

Audit Scope

During the audit planning process, we determined coordination among state, federal and local governments, and the private sector is necessary to effectively facilitate GIS development. The Council is a primary point of contact for GIS development in the state, including coordinating GIS activities among government and private sector entities. We focused on the communication, coordination, and decision-making processes used by the Council and other coordinating groups to expand GIS use and capabilities where appropriate at all levels in Montana: state, local, and private. We looked at GIS development history from the early 1990's, but focused on coordination activities occurring since 1997.

Chapter I - Introduction

The purpose of the audit was to examine activities related to statewide coordination and oversight in support of GIS implementation and development. Therefore, we did not evaluate the effectiveness of individual state or local agency use of GIS.

Audit Methodologies

We interviewed 33 officials involved in GIS implementation and development across Montana. These officials represented all levels: local, state, university system, and federal employees, as well as participants from the private sector. Many of these officials are members of the Council or other GIS coordinating groups. Interviewees included GIS technical staff and mid- and senior-level managers. Interviews focused on determining the roles and responsibilities of the various groups. We also observed coordinating group meetings and reviewed associated documentation to gain an understanding of past and current activities. A large portion of the documentation was obtained on Internet address sites of the coordinating groups.

To examine GIS development and implementation, audit work also included review of:

‣ The executive order establishing the Council.

‣ Operating guidelines for coordinating groups in Montana, including the Interagency Technical Working Group, the Montana Local Government GIS Coalition, and the Montana GIS Users' Group.

‣ GIS activities in other states related to organization, structure, mission, goals, and education.

‣ Literature addressing the use of GIS as a management information tool for government.

During the audit, we monitored proposed legislation during the 2001 Legislative Session that could affect oversight responsibilities for GIS activities. Senate Bill 131, titled "An Act Generally Revising the Laws Governing Information Technology," was approved by the legislature and signed into law, chapter 313, Laws of 2001. This

statute, which became effective July 1, 2001, allows the Montana Department of Administration to increase oversight and management of state information technology systems. The specific impact of Senate Bill 131 on GIS development and implementation within state government is not known. However, SB 131 is just applicable to state agencies, while the efforts of the Council and the other coordinating groups affect all levels of government and the private sector.

House Bill 105, titled "An Act Providing for the Funding of Local and State Geographic Development Projects" was also proposed during the 2001 Session. The Council supported HB 105. The intent of the bill was to establish a funding source primarily for local governments so they could secure match funding to access short notice federal grants. HB 105 was tabled in committee.

Compliance

Our audit focused on the effectiveness of the existing structure for overseeing and coordinating GIS activities in the state. We did not identify any areas of non-compliance with Montana law.

Management Memorandum

During the audit, we noted one minor issue relative to the others identified later in the report. Currently, the executive order establishing the Council designates the Director of the Department of Administration as the chair. Some interviewees indicated a better approach would be to allow the membership to elect the chair. This approach could consider director availability and interest, and consider current priorities of other state agencies. We presented an informal recommendation to the Council regarding revising the executive order and operating procedures to address Council chairperson designation. We suggested the Council establish procedures to allow membership to determine the chairperson.

Future Audit Work

Audit work indicated GIS development has implications for future performance audits of state agency programs. We found the application of GIS by an agency can significantly impact the utility of management information and decision-making processes. While audit scope excluded examination of state agency use of specific GIS

capabilities, we noted the current use of GIS varies among agencies. Some agencies use GIS as an integral part of their management information, while other agencies use GIS little or not at all. Implementation and application of GIS within state agencies is directly related to management information needs. Therefore, future performance audits could include procedures for more directly evaluating the potential for state agency use of GIS applications.

Report Organization

The remainder of this report covers three areas. Chapter II provides background information about GIS capabilities and an overview of GIS activities in the state. Chapter III provides information about coordinating groups and addresses the role of communication and coordination in the development of GIS capabilities. Chapter IV discusses GIS implementation planning, issue resolution, and Montana Geographic Information Council resources. Chapter IV also includes recommendations for improving development and implementation of GIS in Montana.

Chapter II - Background

Introduction

This chapter provides background information about Geographic Information Systems (GIS) applications and capabilities. We include information about framework data development and clearinghouse activities. We also provide an example of framework development by discussing Montana's land parcel project.

What is GIS?

A geographic information system is a computer-based tool for mapping a wide variety of information. The technology integrates database information with the visualization offered by maps. GIS software provides the tools needed to store, analyze, and visually display information. GIS stores and manages information as a collection of layers linked together through geographic references.

One of the goals of GIS is to eliminate redundant data collection and usage. The principle is that data should be collected once and then accessed by all who need it (efficiency). Effectiveness benefits stem from creating a capability to complete tasks that were not routinely done because of their size, cost, or complexity. With GIS, major data projects can be updated regularly and used for routine decision-making. Historically, management information has been agency-specific because there were few means of integrating data of different types. Reliance on hard-copy documentation and personal computer files limited one agency's capability to access another agency's information. Today, information is easily shared among many users through the Internet. Data users are still responsible for determining utility and deciding what to compile when GIS technology is applied.

Any data element that includes a location reference has potential for GIS application. The level of detail in geographic references can be as general as a city, county, or zip code, or as specific as land parcel or global positioning system (GPS) point references. Before geographic data can be used in GIS, it must be converted into an appropriate format. The conversion process can include:

- Assigning a geographic reference to an event or feature.
- Accounting for variations in map scales.
- Putting data into a digital format.

Figure 1 summarizes what GIS is and how it works.

Figure 1

GIS and How it Works

What is GIS?

➢ Computer software tool for assembling, storing, manipulating, displaying (in map form) and analyzing geographically referenced data.
➢ Can be used to display and analyze multiple "layers" of information and help answer questions.
➢ Combines mapping with database management.

How Does GIS Work?

➢ Information is stored in "layers" or "themes" - geographic location as well as attribute information.
➢ Layers can be viewed in various combinations to highlight relationships.
➢ Relationships between layers can be analyzed and the results used to generate maps and tabular reports.

Uses for GIS

Landfill Location

VICTOR

DARBY

SULA
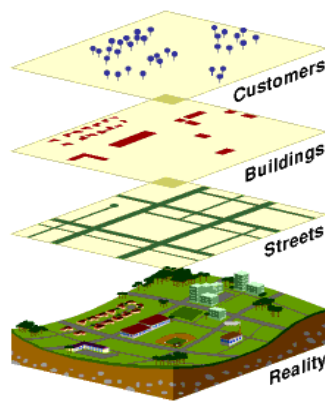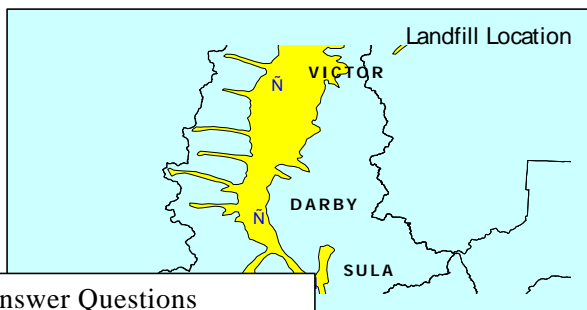
Answer Questions

➢ How big is the basin in square miles?
➢ Where are the data collection sites?
➢ What natural resources exist?
➢ What percentage of the basin is federal land?

Perform Analyses

Questions: Will a proposed injection well affect the river water quality? Is the well within 1/2 mile of the river?

Use GIS to:
➢ Display 1/2 mile buffer around river.
➢ Display all well sites within the buffer.
➢ Locate other possible sites that meet a set of specified conditions.

Proposed Injection Well Site

(Buffer: 2140 ft)
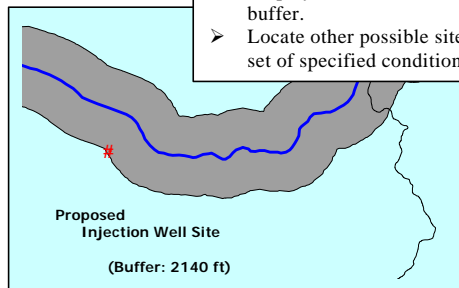
Source: Compiled by the Montana State Library, Natural Resource Information System.

Framework Data Layers are the Foundation

The federal government, in cooperation with state, regional, local, and private sector interests identified seven framework data layers for the nation. Framework layers follow themes identifying geographic features or characteristics, relating to national, state, or regional interests and needs. Geographic features may be either natural or manmade. These layers are:

▸ Elevation and bathymetry (elevation of land and depths of bodies of water).

▸ Hydrography (surface water features such as rivers, lakes, and streams).

▸ Geodetic control (a set of known positions with precisely determined locations from which other locations can be referenced).

▸ Cadastral or land parcel (rights associated with land, such as ownership).

▸ Transportation (features used to move people and goods, including roads, bridges, tunnels, rail lines, and similar features).

▸ Government units (boundaries of entities such as cities, counties, or reservations).

▸ Orthoimagery (aerial photographs or satellite imagery).

In addition to federally established layers, states or local government entities can develop additional framework layers to meet specific needs. Montana's GIS community identified four additional layers:

▸ Geology (surface features).
▸ Hydrologic units (sub-watersheds and drainages).
▸ Land cover (vegetation).
▸ Soils (inventory and classifications).

The development of framework layers provide several benefits. Layers are usually available to users at no or minimal cost. Once a layer is developed, other users do not have to develop their own base layer. Layers can be overlaid upon each other to provide varying levels of detail. For example, the elevation, hydrography, and

transportation layers could be used together to show all three data themes. In addition, layers provide a consistent and accepted base upon which maps can be created.

Framework layers are developed independently of each other. Agencies develop framework layers related to their field of expertise. As an example, the U.S. Geological Survey, an agency with extensive experience creating topographical maps, is responsible for developing the elevation layer. Additionally, a single framework layer is often a compilation of information from different entities. The transportation layer for example, could include information about:

‣ State and federal highways from a state highway department.

‣ City and county road and street information from local governments.

‣ Roads and trails in national forests from the U.S. Forest Service

‣ Railroads from railway companies.

Consequently, a framework layer may be stored in one or more locations, depending on how the total layer was developed. Users may need to contact more than one organization to obtain a complete framework layer.

Framework Layer Status

Framework layer development is time-consuming and the various layers have been undertaken with different levels of resources depending on the entities involved and priorities assigned. As a result, some layers are approaching completion while others are in initial development stages. The following table provides a development status summary, including funding and completion dates, for Montana's eleven framework layers.

Table 1

Status of Montana GIS Framework Layers
(As of May 2001)

Layer	Federal	State-Local	Private	Total Funding	Additional Funding to Complete or Enhance	Projected Maint. Costs/yr	Estimated Completion Date
Cadastral	$1,721,000	$2,849,000	$ 430,000	$5,000,000	$ 1,600,000	$ 500,000	2002
Digital Orthoimagery	$6,120,000	$2,040,000	NA	$8,160,000	$ 780,000	NA	NA
Elevation	$2,300,000	NA	NA	$2,300,000	$ 2,200,000	$ 13,000	NA
Geodetic Control	NA	NA	NA	NA	NA	NA	NA
Governmental Units	NA	NA	NA	NA	NA	NA	NA
Hydography	$ 300,000	$ 85,000	NA	$ 385,000	$ 2,645,000	NA	2004
Transportation	NA	NA	NA	$2,900,000	$ 2,700,000	$ 195,000	2006
Geology	$ 715,000	$ 715,000	NA	$1,430,000	$ 4,200,000	NA	2017
Hydrologic Units	$ 500,000	NA	NA	$ 500,000	NA	$ 500,000	2002
Soils	$2,250,000	$ 250,000	NA	$2,500,000	$17,500,000	$1,200,000	NA
Land Cover	$1,500,000	$ 500,000	NA	$2,000,000	NA	$ 100,000	2001

NA = Not Available

Source: **Compiled by Legislative Audit Division from Montana Geographic Information Council and Interagency Technical Working Group records.**

The table reflects projected costs for data layer development, as well as for future maintenance of layers. Determination of funding sources for both initial data compilation and maintenance is part of the framework development process. Federal agencies are a primary source of funding for many framework layers. However, as the table shows, state and local governments and the private sector are all involved in framework layer funding and the development process.

Montana does not centrally designate GIS funding for development or maintenance of framework layers. Instead, framework development within Montana relies upon individual entities or agencies to justify and provide funding. Consequently, framework layer development can result in long-term projects depending on funding availability.

Chapter II - Background

Maintenance Costs

Maintenance costs for framework layers vary. Some layers require more extensive maintenance efforts due to frequent data changes. For example, the land parcel layer requires constant maintenance because of real property sales and transfers. Layers describing natural features may require less maintenance depending on events such as earthquakes, landslides, or forest fires.

GIS Data Sets

Unlike framework layers, data sets typically refer to GIS data collected for specific management information purposes. Management information such as a city or address location, can be converted directly into GIS format. For example, an agency regulating petroleum storage tanks maintains a database with tank information such as the owner's name, age of a tank, history of leaks, and the tank location. Using GIS, the agency can create either a simple list of owners and tanks, or a map showing the same information. A user could also overlay this information onto a transportation and hydrology layer to show tank locations relative to roadways, or the proximity of tanks to water resources. Examples of Montana data sets include:

< 2000 U.S. Census Data
< Wildlife and habitat management areas
< Hunting districts
< Petroleum storage tanks
< Mine locations
< Wastewater permits
< Land use in Butte
< Water wells

Public Access to GIS Data

Framework layers and data sets compiled by government agencies are generally considered public information unless protected by privacy laws and regulations. For example, the land parcel layer is considered public information because land ownership is a public record. Framework layers and agency data is generally available for no or minimal charge. According to Montana law, governmental agencies may not charge fees for existing data to cover collection costs. However, agencies may assess reasonable costs associated with providing requested data or for performing requested additional work. GIS data collected and maintained by private sector entities

may be considered proprietary information and sold at their discretion.

GIS Development and Oversight

GIS development and use is dependent upon sharing data among multiple agencies at all levels (state, federal, local, and private sector). No single state or federal agency has direct authority for controlling the collection, storage, dissemination, or use of GIS applications and data. An organization was established at the federal level to facilitate development and use, because interagency coordination and communication is needed to assure a consistent approach.

Federal Government Activities

The federal government assumed primary responsibility for developing national standards and promoting GIS development. Federal standards and guidelines are minimum expectations for development. The U.S. Office of Management and Budget established the Federal Geographic Data Committee to promote the coordinated use, sharing, and dissemination of geographic data on a national basis. The committee, chaired by the Department of Interior, is composed of representatives from 17 federal agencies. By providing funding for cooperative federal, state, and local projects, the goal of the committee is to encourage resource sharing. State and local governments and other organizations work in partnership with the committee to promote GIS. The committee coordinates the development of the National Spatial Data Infrastructure.

National Spatial Data Infrastructure

The National Spatial Data Infrastructure was established by presidential executive order in 1994. The infrastructure is defined as the technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and non-profit sectors, and the academic community. The infrastructure was established to provide a consistent means to share geographic data among all users, to produce significant savings for data collection, and enhance decision making. The infrastructure: identifies criteria for data development, establishes procedures for building and using data (standards), and outlines institutional relationships and business practices (promotion of GIS).

Chapter II - Background

Montana GIS Clearinghouses

Clearinghouses provide access to, and information about, GIS data similar to a library providing access to other documentation. Clearinghouses accept GIS data and a category of information known as metadata. A metadata file provides information such as: the type of data collected (addresses, list of features), data attributes (alpha, numeric), how the data was collected (survey, GPS), and the quality of the information (accuracy, scale). These files permit users to become aware of available data and to evaluate the usefulness of data before reviewing the information.

Although the general purposes of clearinghouses are similar, most focus on specific types of data or reflect regional interests. As a result, there are a number of clearinghouses in Montana. As part of their library function, clearinghouses often provide referral services and Internet links to other clearinghouses.

Montana Natural Resource Information System

The Natural Resource Information System (NRIS) is generally considered the primary clearinghouse in the state. The 1985 Legislature created NRIS in the Montana State Library as a repository for natural resource information such as geographic features and water resources. Its mission is to provide Montanans with comprehensive and accurate information essential to managing natural resources. The NRIS repository focuses on natural resource information and provides access to a broad range of related information. In addition to its clearinghouse role, NRIS administers two programs:

▸ Natural Heritage Program is the state's source for information on the status and distribution of sensitive biological features, emphasizing vulnerable species and outstanding habitats. The mission is to collect and provide information on species, natural communities, and other features of concern.

▸ Water Information System provides information about surface water, water quality, riparian areas and water rights.

The Internet address for NRIS is http://nris.state.mt.us/.

An example of GIS data available through NRIS follows in Figures 2 and 2 (cont'd.):

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 2

NRIS Clearinghouse Data

The Montana Thematic Mapper application is an Internet mapping tool for accessing a wide variety of information about Montana's natural resources.
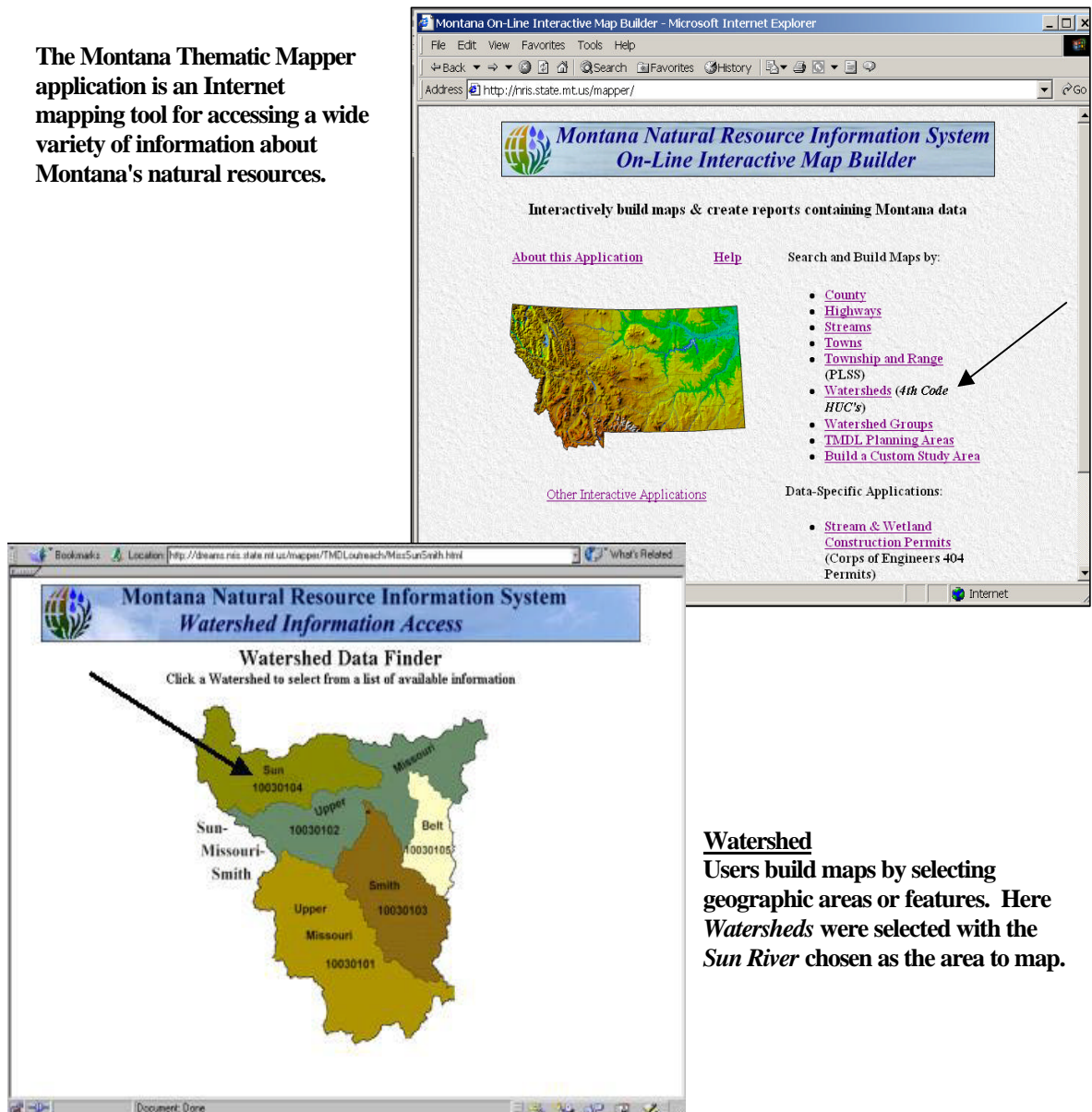
Watershed
Users build maps by selecting geographic areas or features. Here *Watersheds* were selected with the *Sun River* chosen as the area to map.

Source: Prepared by the Montana State Library, Natural Resource Information System.

Figure 2 (Cont'd)

NRIS Clearinghouse Data

Public Water Supplies
The application allows the user to select from nearly 30 categories to create maps and summary reports.
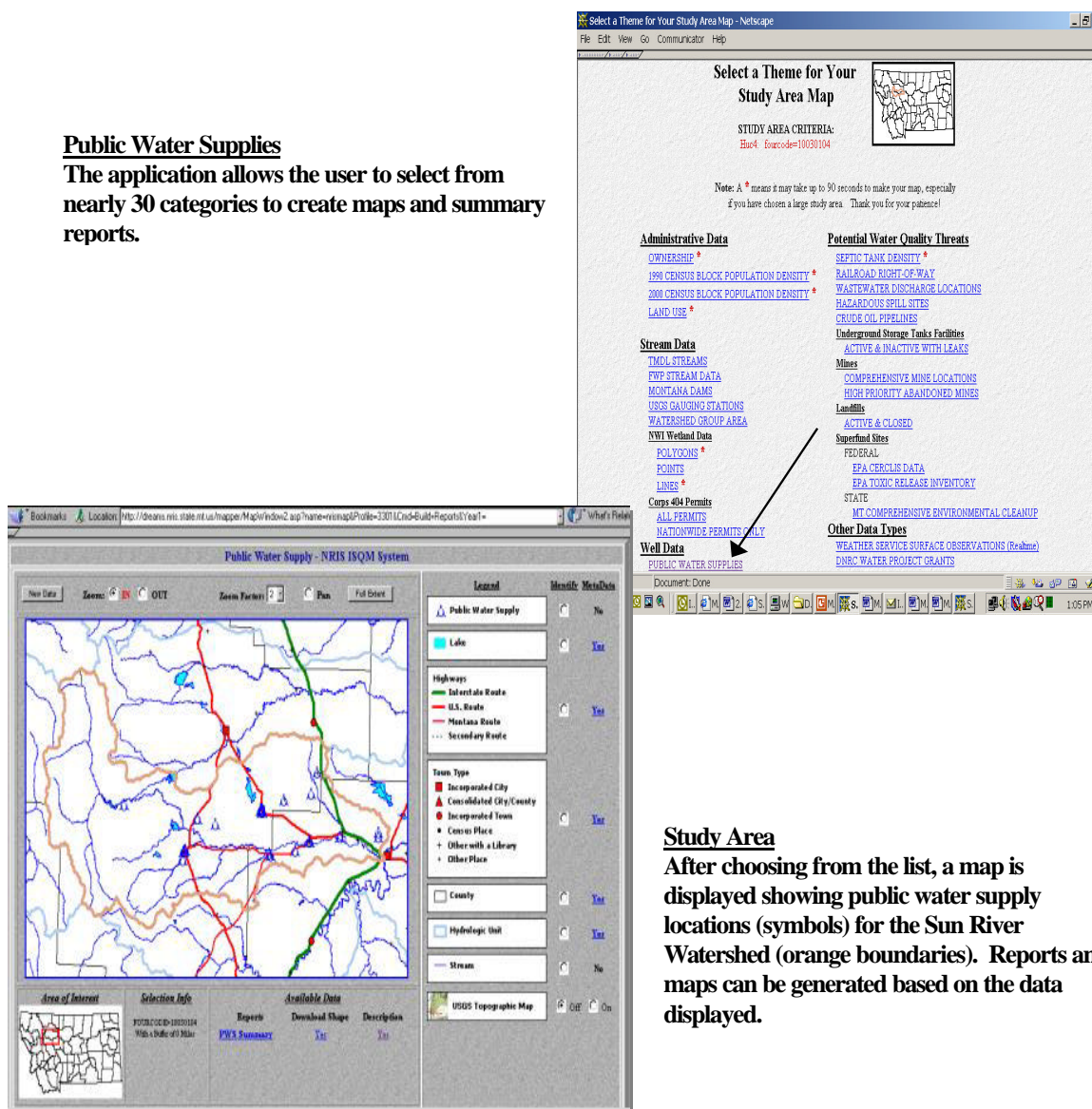
Study Area
After choosing from the list, a map is displayed showing public water supply locations (symbols) for the Sun River Watershed (orange boundaries). Reports and maps can be generated based on the data displayed.

Source: Prepared by the Montana State Library, Natural Resource Information System.

Chapter II - Background

Census and Economic Information Center

The Department of Commerce, Census and Economic Information Center (CEIC) is designated by the U.S. Census Bureau as the State Data Center and Business/Industry Data Center for Montana. The center is designated by federal law as Montana's repository for federal census data. The CEIC offers a variety of mapping, geographic, and GIS data resources and services related to census and business data. Under a formal agreement to develop and implement a shared data service, CEIC and NRIS work together to provide online clearinghouse services to capitalize on the skills of both organizations. The Internet address for CEIC is http://ceic.commerce.state.mt.us/.

Example of Framework Layer Development

As previously discussed, framework layer development is usually a cooperative effort. Montana's land parcel layer is an example of a layer supported by federal, state, and local governments, as well as the private sector. In the GIS community, this layer is known as the cadastral layer, and it contains information on property ownership and boundaries. In the following sections, we discuss the state's land parcel or cadastral project to provide an example of the framework layer development process.

What is Cadastral?

A cadastre is an official register of quantity, value, and ownership of real property used for apportioning taxes. This information is also used to record property boundaries, subdivision lines, buildings, and related details. Property ownership information in Montana is recorded by county clerks and recorders. The land parcel project converts property and parcel information collected at the county level to an electronic format.

The land parcel layer is not a single data set maintained by the state. Instead, the layer consists of multiple data sets developed by the state and local governments through a cooperative effort to create a comprehensive statewide layer.

Project Responsibility

The state assumed primary responsibility for statewide development and coordination because property ownership and rights information is necessary to apportion property taxes. The Department of

Revenue (DOR) is responsible for transferring data and maintaining the layer for most counties in the state. One of the uses of the electronic parcel information is by the Montana Department of Revenue for property tax administration. Eight counties retained responsibility for direct data transfer and maintenance. These counties possess the resources needed to maintain their portions of the layer. In most instances, requests for parcel information from these counties would process through the county, rather than the central Internet site supported by the Department of Administration (DofA). The Internet address for cadastral information is http://gis.doa.state.mt.us/cadastral/mapsearch.html. The following figure shows the results of a data inquiry from the land parcel system.

Figure 3

Land Parcel Example

Once connected to the land parcel Internet address, the first step is to select a county. In our example, we are interested in identifying the property surrounding the Department of Correction's Pine Hills Juvenile Correctional Facility. Therefore, we select Custer County from the Montana map. From the county map, we highlight Miles City (step 2). By zooming in on Miles City, we can identify and select the Pine Hills property (step 3). Step 4 shows the system's general parcel information for the Juvenile Correctional Facility. In addition, the system can identify all property and property owners adjacent to the facility.

Step 1

Step 2

Step 3

Step 4
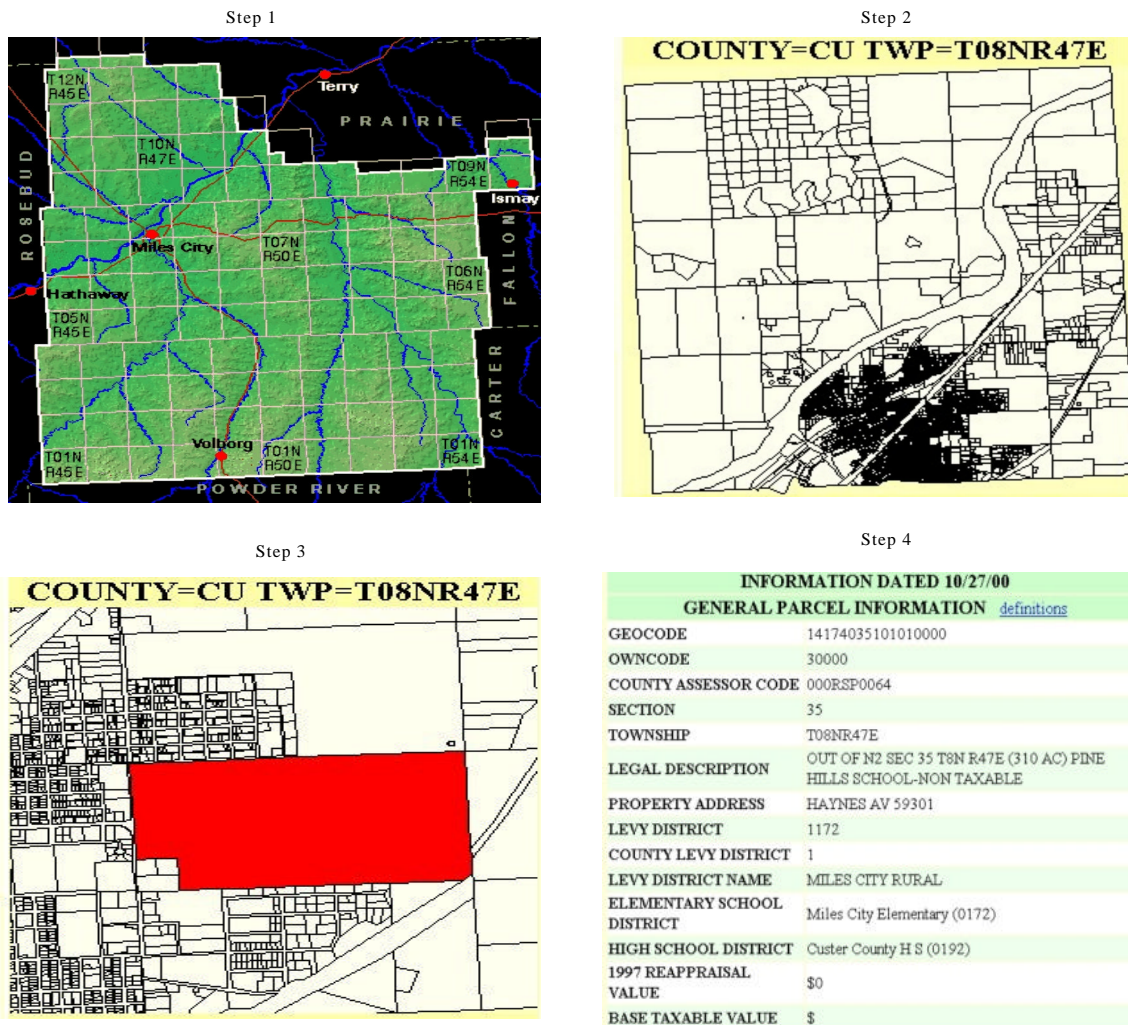
Source: Prepared by the Department of Administration.

**History of Cadastral
Development**

Montana's land parcel project was initiated in November 1996 with development of a project plan and efforts to fund the project. The initial project and technical teams included representatives from DOR, DofA, and other state agencies, as well as representatives from local governments, federal government, Montana university system, and private sector. The 1997 Legislature appropriated funds for development and the project officially started in January 1998 after project managers acquired additional federal funds. Early efforts focused on evaluating existing systems and data conversion processes. The project entered the second stage in the fall of 1998. Activities included:

< Setting priorities for current and future county mapping and maintenance activities.

< Obtaining more private sector support and continued state and federal funding.

< Developing web-based data dissemination capabilities.

< Developing data maintenance procedures.

< Assisting in training programs for data maintenance staff.

Current Status

The project continues through the present with mapping efforts and development of improved data conversion capabilities. Initial mapping is complete for more than three-quarters of the counties. The projected completion date for the land parcel layer is calendar year 2002. The following figure shows the status of the land parcel layer for all Montana counties.

Figure 4

Montana Cadastral Database Project
Parcel Mapping Status – 06/11/2001

*	Counties with Cadastral Database contracts
■ (gray)	Counties not started yet
■ (yellow)	GIS counties with ongoing parcel mapping efforts
■ (green)	Counties undergoing final research at vendor/county
■ (tan)	Counties complete - in or awaiting maintenance

Note: Counties listed as complete may be undergoing a final research phase to eliminate unresolved parcels.
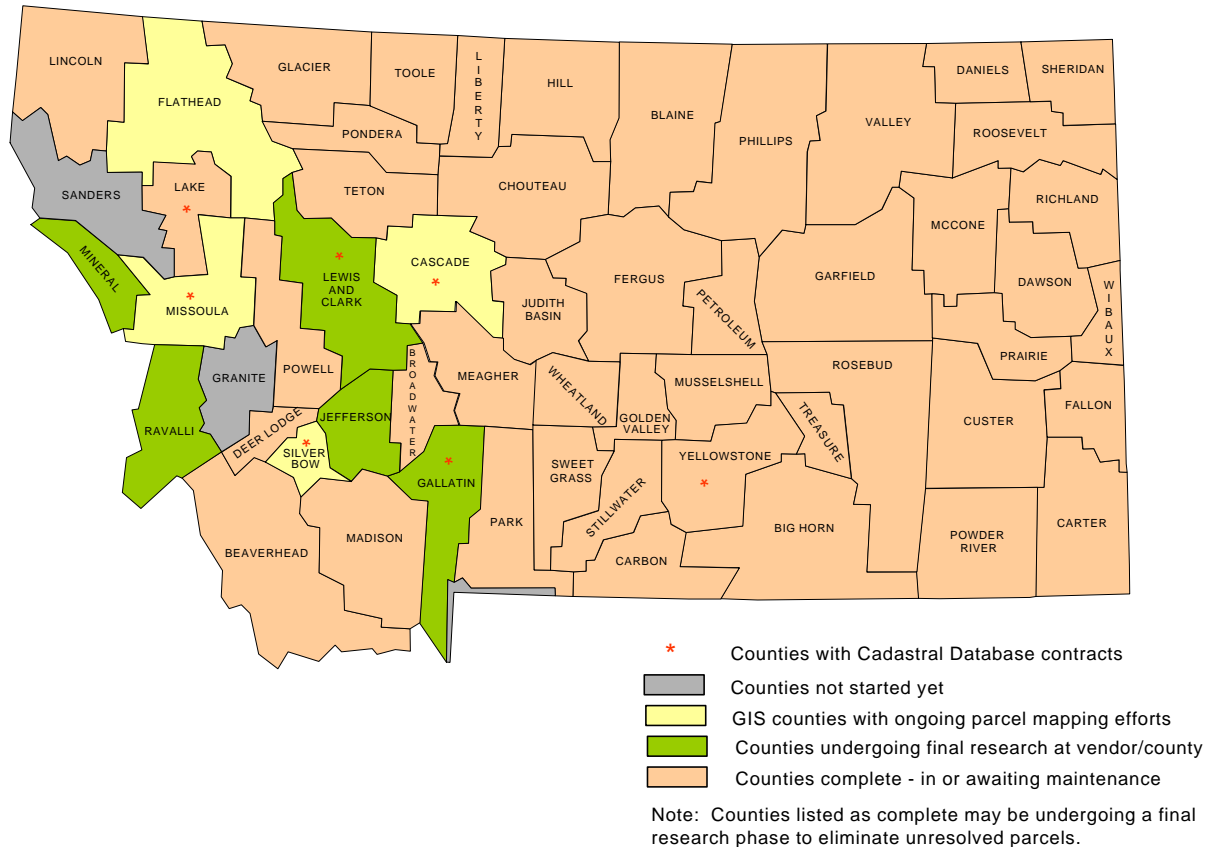
Source: Prepared by the Department of Administration

Project Funding

Funding for land parcel framework layer development came from state, federal and local governments as well as the private sector. The following table reflects funding and funding sources for the development of the land parcel layer from fiscal year 1997-98 through 1999-00.

Table 2

Funding for Montana Cadastral Project
(Fiscal Years 1997-98 through 2000-01)

Funding Source	FY1998	FY1999	FY2000	FY2001 (Projected)	Total
General Fund	$90,000	$60,000	$51,000	$51,000	$252,000
State Special Revenue	$50,000	$50,000	$50,000	$50,000	$200,000
Private Sector Contributions	$110,000	$110,000	$105,000	$105,000	$430,000
Federal	-	$621,000	$300,000	$800,000	$1,721,000
Total (Note)	$250,000	$841,000	$506,000	$1,006,000	$2,603,000

Note: In addition, state and local governments have combined for a total of $2.4 million in in-kind services and data value for matching funds to qualify for federal funding.

Source: Compiled by Legislative Audit Division from Department of Administration records.

Other States

To compare Montana's GIS implementation and development process to other states, we examined information from 14 states across the country. We found most state coordinating or oversight organizations are established by either state law or executive order similar to the order establishing Montana's Council. Most of the other states coordinating group memberships resemble Montana's, although we noted three states restrict membership to state agency representatives.

The roles and responsibilities outlined in charters and executive orders in other states are similar to Montana's, with emphasis on coordinating GIS activities, assuring standardization, and establishing policy direction. Several state oversight and coordination organizations are responsible for distribution of centrally appropriated funding for GIS implementation and development.

We also identified other states' organizations which are responsible for establishing funding priorities and identifying potential funding resources. In some cases the organization is responsible for

presenting these to either their governor or legislature. In contrast, Montana does not appropriate GIS development funding centrally.

Half of the states we looked at appropriated funding for administrative support for the GIS oversight/coordination group. Also, several states employ full-time staff to facilitate statewide oversight/coordination efforts and directly support the primary state coordination group. In Montana, coordinating group administrative support is designated by executive order to DofA.

Chapter III - Communication and Coordination

Introduction

The Environmental Protection Agency (EPA) and private companies involved in Superfund site activities funded early GIS development in the state. The majority of Montana's initial GIS users were associated with natural resource organizations involved with the EPA and Superfund site activities. To facilitate development, users established groups to coordinate sharing of data and resources and the development of data standards.

During the audit, we identified four organizations which assumed primary responsibility for developing and coordinating GIS activities:

< Montana GIS Interagency Technical Working Group (Technical Group). Internet address: http://mtgeo.org/itwg/.

< Montana Local Government GIS Coalition (Local Coalition). Internet address: http://sunl.giac.montana.edu/mlggco.html.

< Montana GIS Users' Group (Users' Group). Internet address: http://mtgeo.org/mtgis/.

< Montana Geographic Information Council (Council). Internet address: http://gis.doa.mt.us/mgic/.

For this report, we will refer to these groups as indicated above. The GIS community usually refers to the groups using multiple letter acronyms.

It is not uncommon for representatives from one group to serve or participate in the activities of another group. In addition, these groups may schedule overlapping meetings to facilitate communication between one another. The following sections provide an overview of the primary coordinating groups in Montana and explain the inter-relationship of their roles and responsibilities.

Technical Group

The Technical Group, generally recognized as the first formal GIS coordinating group in Montana, was established in the mid-1980s. The group focuses on technical issues and promotes standardization of GIS data. State and federal natural resource agencies established

the Technical Group to coordinate the collection and storage of GIS data among agencies, document the usability of GIS data, and facilitate sharing of available natural resource data. Although the group's history is based on early GIS activities related to natural resources, the membership has expanded to include representatives from non-natural resource fields such as the Montana Departments of Commerce, Revenue, and Transportation. This group has a primary role for providing technical and project assistance to the Council.

The Technical Group operates under a Memorandum of Understanding (MOU) outlining their purpose, objectives, and standard operating procedures. Membership requires agencies or individuals to become signatories to the MOU. Seventeen state, federal, and local government agencies have signed the MOU. The group also encourages private sector entities to participate as members. Participation by non-signatory organizations in group meetings further stimulates communication and coordination. Only representatives of signatory agencies may vote when consensus is required.

Local Coalition

The Local Coalition was established in 1995 to facilitate and advance municipal and county government use of GIS through communication and data sharing. The Local Coalition operates under a set of bylaws governing its activities. The group's goals include:

< Promoting a bottom up approach for data acquisition beginning at the local level.

< Facilitating an exchange of ideas among local government GIS users.

< Providing information through workshops, seminars, and meetings.

< Establishing a forum to identify common problems and unified solutions to benefit municipal, county, and state entities.

< Providing inexperienced computer users with information and technical assistance.

Additionally, the Local Coalition represents and advises members on state and regional technological issues. The group is also a primary resource for the Council, particularly for technical issues directly impacting local government activities and issues related to the development of major data layers intended to be used at all levels.

Users' Group

The Users' Group is a consortium of GIS practitioners from all sectors. The group was established by a charter in 1990. The Users' Group provides a forum for discussing a wide range of GIS issues impacting government, public schools, and the private sector. The group publishes a quarterly newsletter addressing on-going GIS use and development activities across the state. This group focuses on promoting and expanding the use of GIS through education and outreach. In coordination with the Northern Rockies chapter of the Urban and Regional Information Systems Association, the group sponsors the annual Intermountain GIS Users' Conference held in either Idaho or Montana. The Users' Group also sponsored development of a K-12 GIS curriculum that includes tools and resources for teachers. Additionally, the Users' Group provides scholarships to graduate-level students enrolled in GIS programs in the Montana University System. This group works with the Council and the Technical Group assuring collaborative GIS development efforts to anticipate the needs of all sectors in Montana.

Council

The Council was established by executive order in 1997 and is responsible for promoting the coordination of GIS activities in the state. According to the order, one of the duties of the Council is to "provide policy level direction and promote efficient and effective use of resources" relating to geographic information. The approach used by the Council to achieve this goal is to establish consensus through a membership that includes representation from the three organizations described in the previous sections. Council membership includes: state agency directors, municipal and county officials, federal agency officials, and representatives of the university system, Indian tribes, and the private sector. The executive order instructs the Council to:

< Promote cooperation among state, federal, and local agencies and the private sector.

< Review and establish priorities for GIS needs.

< Facilitate cost-sharing and collaborative arrangements.

< Promote coordination to maximize opportunities, minimize duplication, and facilitate the documentation, distribution, and exchange of information.

< Ensure development of consistent policies, standards, and guidelines.

< Complement and enhance ongoing coordination efforts.

< Serve as the primary point of contact for national, regional, and other states' GIS coordinating groups.

< Provide recommendations to the governor and the legislature.

The executive order instructs the DofA to provide administrative support to the Council. The executive order also gives the Council authority to request assistance from other coordinating groups or the private sector as needed. The Council does not receive direct legislative appropriations to fund operations.

Council Working Groups are Used to Define and Resolve Issues

Council operating procedures allow for a process to establish working groups to address issues related to GIS development. The Council may appoint working group members from its membership or request assistance from other coordinating groups, government agencies, or the private sector. The intent of the working groups is to provide a methodology for establishing consensus and develop recommendations for the Council consideration.

Cooperation and Collaboration

Cooperation and collaboration are fundamental to the development of GIS capabilities, because success relies upon establishing large data bases used by entities at all levels throughout the public and private sectors. The development of framework data layers is necessary to provide foundations upon which entity-specific data sets can be applied and used for decision-making. Development crosses many government and private sector jurisdictions. Frequently

development also means the integration of multi-discipline data. As a result, a project advocacy approach evolved in Montana. While the Council is often viewed as the focal point for GIS advocacy, we found all four of the primary coordinating groups routinely serve in an advocacy capacity.

The role of the Council is defined by executive order and the role of the Technical Group is defined in the memorandum of understanding signed by the members. Both emphasize communication and coordination. We found both organizations rely on the spirit of cooperation to achieve consensus to implement and develop GIS capabilities. The range of topics considered by the two groups suggests the focus is statewide GIS activities. Development of state government capabilities is an important topic. However, development and enhancement of framework layers regardless of jurisdictional lines receives the most emphasis. The missions of the Local Coalition and the Users' Group are more specific to their memberships. However, these two groups also focus extensively on communication and coordination as the approach for expanding GIS development.

Communication and Coordination Leads to Cooperation

Based on our review, we determined the amount of communication and coordination between these four groups is significant. In part, this is because members from one organization frequently participate as members of another, or attend another group's meeting. More significantly, we believe the level of communication and coordination is achieved because the majority of the members in all of these organizations are active GIS participants. GIS development in Montana has been effective as a direct result of the participants strong commitment to communication and coordination.

The land parcel project is probably the most notable example of a collaborative effort stemming from communication and coordination. This framework layer was developed using a combination of state, federal, local, and private sector funding. Similarly, data collection involved entities at the state, local and private sector level. However, there is much more to GIS development than the land

parcel project. The capabilities of, and access to, clearinghouse activities at CEIC and NRIS are examples of communication and coordination efforts to minimize duplication while providing data access. Further, progress towards development of the other ten framework layers in Montana has led to increased involvement of state, federal, local, and private sector GIS users.

Duplication and Cost-sharing

Data development is the most significant cost factor for most GIS projects. For other governmental information technology systems, hardware and software frequently generate the majority of the cost. For GIS, reducing data duplication and maximizing cost-sharing are important aspects of the development process. Cost-sharing occurs routinely throughout the GIS community. As a result, most participants believe duplication of data is also minimal. We noted the intent of the state land parcel project to develop a single integrated layer. While complete integration is not yet possible, it's still the long-term goal as different entities participate in on-going data update efforts. We also noted federal agencies provided extensive funding resources for developing and collecting data for other GIS framework layer development in the state. The emphasis on cost-sharing and minimizing duplication is obvious for the eleven framework layers.

All four coordinating groups support the concept that agencies with common interests and mutual information needs should share in development and data collection efforts. This approach minimizes duplication of effort and increases effectiveness. Cooperative agreements promote development of projects that may not be possible for a single agency and help distribute costs among primary users. Emphasis on the use of clearinghouses to store and disseminate data to multiple users is another indicator of efforts to reduce duplication and cost.

Conclusion:
Communication and
Coordination is Effective

We conclude the existing organizations and oversight processes effectively use communication and coordination to develop GIS capabilities. There have been benefits from using the spirit of cooperation approach to focus on specific projects and encourage the use of GIS. Further, the cooperative relationships between the Council, Technical Group, Local Coalition, and Users' Group help to minimize duplication and increase cost sharing.

In chapter IV, we examine the planning and issue resolution activities of the Council.

Chapter IV - Improving GIS Administration

Introduction

In this chapter, we discuss potential improvements to overall administration of GIS in Montana. While all the GIS groups are involved in coordinating and sharing resources, the Council has statewide responsibilities such as: reviewing and establishing priorities for GIS needs; ensuring development of consistent policies, standards and guidelines; and promoting efficient and effective use of resources. Therefore, we direct our recommendations to the Council.

We discuss planning issues such as how to bring new entities into the GIS field, GIS training, data layer custodianship, and standardization of data. In addition to planning, we recommend improving the process for resolving legal issues and issues associated with assigning roles to participants in the GIS community. We end the report with a section on the need for the Council to assess the requirement for sufficient resources to perform its statewide responsibilities.

Planning

Based on our experience in reviewing other major state government projects affecting multiple agencies and jurisdictions, we anticipated the Council would be monitoring an overall planning effort for GIS development in the state. As part of the planning effort, we expected the Council would be comparing various project statuses to either specific project plans or to an overall state implementation plan.

In January 1999, the Council prepared a report titled Geographic Information Systems: An Interim Report on the Status and Outlook. In this report, the Council indicated developing a well-defined state plan for collection of, and analysis of, geographic data was important. However, with the exception of the land parcel project, we found formal planning has been limited.

Some Local Governments and Other States Formalize Planning

During our review, we noted several local governments in Montana prepared GIS implementation plans as part of their development process. These planning efforts included detailed data needs assessments, surveys of staff, and identification of department uses

for GIS capabilities. In addition to projecting cost baselines for implementation, these local efforts established initial priorities and set milestones to determine when various capabilities should be available to multiple department users. Further, our review of other states indicated several also formalized their GIS development approach by preparing statewide implementation or strategic plans.

State-level Progress Based on Cooperation and Persistence of Participants

We noted the Council and the Technical Group routinely receive updates on the development of framework layers (described in chapter II). However, project status is not compared to planning projections or milestones because in most cases they have not been formally developed. The current status reviews heard by the Council do not appear to specifically influence progress of framework projects. Project progress appears to be primarily a function of the persistence of the individual or individuals most interested in seeing the project completed and making the data useful. For most framework layer projects, individual points of contact coordinate efforts. On occasion, we noted framework project participants may request Council assistance to help arrange funding.

In 1998, the Council commissioned a study to assess methods used to measure costs and benefits of GIS implementation. One purpose of the cost-benefit analysis was to help devise a set of guidelines for future implementation planning. While the analysis recognized the positive cost-benefit of GIS applications to state agencies as well as other government and private entities across Montana, neither formal project plans nor an overall state plan resulted from the effort.

Recently, the Council and the Technical Group endorsed a planning approach proposed by the Federal Geographic Data Committee to assure consistency between states. As a result, Technical Group members developed plan abstracts for Montana's eleven framework layers. Our review of these documents reveals many inconsistencies in areas such as identifying funding requirements, needs assessments, funding sources, and project priorities. Technical Group members are aware of these deficiencies and were continuing to refine the documents during our audit. The development of these

plans is a good approach. It is important for the Council to establish long-term goals for this process to assure progress and consideration of costs, funding sources, and milestones.

Planning Impacts Many Areas

From our interviews and observations, we determined the shortfall in planning impacts several more specific areas of GIS development including:

< Increased user participation.
< State employee training.
< Data custodianship.
< Standardization process.

In the following sections, we examine each of these areas.

Participation

Several nationally recognized periodicals indicate between 80 and 90 percent of the data compiled by government entities has a geographic or spatial reference and could be converted for GIS application. In Montana, there are many opportunities to involve more state and local agencies and the private sector in GIS application. Expansion not only allows these additional entities to make their current operations more efficient and effective, because of better access to information, it creates opportunities for greater sharing of additional data by the community as a whole.

State Agency Participation

We surveyed state agencies to determine the level of GIS involvement within state government. Agencies directly involved with Council, Technical Group, or the other coordinating groups generally used GIS applications the most extensively. About one third of state government agencies do not participate in Council or Technical Group activities and have not developed capabilities.

In some cases, agency officials were not aware of the positive implications of converting their existing data to allow for visual application of management information in a map format. Some agency officials were concerned with the cost of implementing GIS in their agency. While cost is a concern, officials may not be aware of reductions in the cost of hardware and software in recent years.

Chapter IV - Improving GIS Administration

Further, agency officials have not been exposed to various cost-benefit analyses associated with GIS use.

Local Government Participation

While a review of capabilities within municipalities and counties was beyond the scope of our audit, we discussed the level of local government GIS participation with interviewees. We found several municipalities and counties are advanced in terms of GIS capabilities. Many other local government entities have yet to pursue GIS alternatives. Again, the most frequent concerns related to knowledge of capabilities and funding.

Commitment to GIS Expansion

During our review of other states GIS oversight activities, we found many include an education or advocacy component. Montana's executive order also subscribes to a strong commitment to using GIS. We identified efforts by NRIS, the Local Coalition and the Users' Group to provide non-participating state agencies and local governments with expertise and equipment to expose them to the benefits of GIS. However, interviewees also suggested a primary focus for Montana has been on projects and issues directly affecting members and their organizations rather than advocacy and increased participation.

Events such as the 2000 fire season and initial planning for framework layers such as transportation highlighted the need to expand GIS capabilities and to involve more participants. As a result, in recent months the Council and the Technical Group, along with the Local Coalition and the Users' Group, are working to expand state and local involvement by encouraging participation.

Planning Emphasis Could Increase Participation

Based on the proposition that 80 to 90 percent of all government data has a geographic reference, we believe it is advantageous for more state and local entities to become involved. GIS could provide opportunities for better decision-making, increasing information sharing, and reducing costs through increased efficiency. To assure expansion and more participation and to utilize the capabilities GIS offers, it is important for the planning process to consider

participation and identify areas where GIS can offer improved efficiency or effectiveness.

State Employee Training

During our interviews, we asked GIS users about training. Most indicated there are different degrees of expertise, which require multiple levels of training. The most complex level would involve database development and could include conversion of existing data to a GIS standard format. Next is the need for training for a GIS technician responsible for using available GIS hardware and software to create location-related documents for management and staff. Finally, the general user of GIS products needs to know how to access data and choose from available products.

User Application Training is Limited

We focused on the availability of GIS training for state agency staff and asked what was available. We found technical training is readily available from the private sector. Staff indicated this was an appropriate source because of the differences in hardware/software and data standards. Training for agency management, supervisors, and program staff related to the use or application of GIS for improving government operations is not nearly as available. We believe this level of training would help agencies that have not yet developed GIS applications learn about the benefits of the technology.

We identified multiple state agencies that developed their own internal training for staff. While this approach met the short-term needs of each agency, officials suggested a common application course would be more useful and reduce duplication. Further, a baseline course could support new GIS users, staff turnover, and ongoing training necessitated by new technology.

Various officials suggested the following options for the provision of GIS training for state employees:

< Designate training responsibility to an agency such as NRIS, already involved in assisting agencies with project development.

Chapter IV - Improving GIS Administration

< Request development of basic GIS application courses by the Department of Administration (DofA), Professional Development Center.

< Request DofA develop or contract for GIS general application training to assure standardization.

Planning Emphasis Would Highlight Training Requirements

We identified reasons why a state-sponsored approach to GIS training has not been pursued. First, those state government organizations typically providing management training have not considered GIS as a tool for management decision-making. In addition, most of the active GIS participants were motivated to pursue courses of action resulting in the quickest payback that provided an immediate enhancement of their individual GIS capabilities. By dedicating their own time and energy to training, the quickest paybacks were achieved.

Coordinating groups such as the Local Coalition and the Users' Group are developing training alternatives for other entities within the GIS community. These include training for local government officials and elementary and high school teachers, and the private sector. This area could be considered a training option for state employees as well.

Emphasis on GIS training for agency staff is influenced by the limited formal GIS planning. We noted training was a specific factor identified in the plan prepared for the land parcel project. A formal planning process would highlight training needs for other projects and/or agencies as well. Given the management commitment to GIS expressed in the executive order, the Council should become the advocate for state employee training, and should consider the needs of staff and officials at all levels as part of their planning review process.

Data Custodianship

Typically, a framework layer custodian is the focal point for collecting information because the data comes from multiple sources. The custodian is also responsible for compiling data and assuring completeness and consistency. Custodians can also provide direction for developing plans, data compilation, standardization, access, and

use of data. Moreover, resolution of issues related to these topics is easier to coordinate with a designated custodian or point of contact. Designation of custodians for framework layers is a concern of many GIS participants across the state. Examples of framework layer projects that do not have a designated custodian include: vegetation, transportation, governmental units, and geodetic controls.

Meeting minutes from both the Council and the Technical Group reflected discussion of data layer custodianship issues.   The Council and its working groups worked on formalizing a definition of custodianship for two years. Interviewees indicated data layer custodians may change during the layer development process, because custodianship responsibilities can vary as development evolves. During initial creation of data one entity could be the best candidate, but designating another for maintenance may be more appropriate. On-going maintenance of data is necessary to maintain layer integrity. If custodians are not established, resources used to compile information may be wasted or duplication can occur.

Reluctance to Assume Custodianship Because of Cost

Some agencies are reluctant to assume custodianship because of costs associated with initial development and data maintenance. Cost concerns are more significant when data is derived from multiple agencies. A multi-agency cost-share formula may be needed to adequately address data maintenance costs. Custodian designation should consider the most effective use of all available resources. Once a custodian is designated, the agency can include GIS development and maintenance costs in budget projections and requests. Comprehensive project planning should highlight custodianship requirements, identify alternatives/resources, and establish milestones reflecting when a custodian is needed. If the Council were to recommend agency custodianship, the agency could use the recommendation as support for future funding requests.

Planning Emphasis Could Help Identify Custodians

We believe authority for the Council to identify potential data custodians and to make recommendations is included in the intent of the executive order. To assure optimal use of available resources, any Council recommendation regarding the designation of custodians should incorporate input from the Technical Group and other

coordinating groups, as well as involved federal, local, and private sector participants.

Standardization Process

A primary expectation of the GIS community is the ability to share information. Without established standards, data collected by one agency may be unusable or may have limited application for another agency. Standardization in GIS applications can refer to several different activities, including attributes, accuracy or collection procedures, and completeness and consistency. Standardized data is critical when agencies respond to requests for data crossing jurisdictional boundaries. Standardization can also:

< Reduce the risk of duplication.
< Minimize data conversion costs.
< Reduce costs for transitioning data to new technologies.
< Improve development of framework or other major data layers.

There is unanimous agreement regarding the importance of GIS standards. However, most interviewees also said Montana needs to improve the standardization process. With the exception of a requirement for metadata and statute requiring the use of a standardized survey referencing system, Montana has not formally adopted standards for framework or other major layers. The Federal Geographic Data Committee is in the process of drafting standards for various framework layers and data themes.

Spirit of Cooperation Achieved the Current Level of Standardization

According to the executive order, the Council is responsible for ensuring the development of consistent policies, standards, and guidelines for GIS. Most interviewees indicated the effectiveness of standardization to date stems from the cooperative efforts of the active GIS community rather than the establishment of policy by the Council. Only the land parcel layer has established Montana data standards. An approach to data standardization was outlined in the land parcel development plan. These standards, however, are part of agreements between the Department of Revenue (DOR) and local governments and primarily address DOR needs for parcel information for tax purposes.

Some of the framework layers already have designated federal standards because federal agencies are the custodians. Interviewees expressed concern about the timeliness of establishing standards for the remaining layers as well as for future data sets, which might be created by state or local entities. Similar to the custodianship issue, the setting of a standard such as accuracy for a particular data layer could result in increased costs for one or more of the participating entities. However, if the requirement for the standard was recommended by the Council, it should help support agency requests for funding.

Planning Emphasis Could Enhance Standardization Process

While encouraging standardization, the Council has not established a process for adopting standards for most framework layers or major data sets. The determination of the need for data standards and when to implement standardization are both important planning decisions. The Council should establish a formal planning review process, which considers the need for standardization for framework layers and major data sets. This consideration should be useful for guiding state GIS implementation in the future.

Council Focus on Planning Should Improve Effectiveness

In the previous sections, we discussed areas that could be improved with more emphasis on planning. Increasing state and local agency participation, increasing access to training, timely designation of custodians, and improving the standardization process are all activities that could be enhanced with more focus on formal planning. Council members would have a better opportunity to compare project status, already provided on a routine basis, to established project goals, priorities, and milestones. Future GIS development will continue to require significant inter-jurisdictional cooperation and agreements. We believe the Council role as a facilitator in this process is important. More emphasis on planning by the Council should help GIS development and the establishment of capabilities statewide.

Chapter IV - Improving GIS Administration

> **Recommendation #1**
> **We recommend the Council establish a framework layer project planning review process, to include review of:**
>
> A. **Cost, funding sources, and milestones.**
> B. **Entity participation and training needs.**
> C. **Data custodianship.**
> D. **Standardization requirements.**

Issue Resolution

The GIS community involves all levels of government and the private sector. Progress and growth rely on cooperation and communication among all of the participants/groups. In this environment, where an agency must rely on outside entities, difficult decisions must be made to assure the overall effort stays on track. Sometimes these decisions will result in an outcome that may not appear to be in the best interest of a particular agency. However, the decision benefits the GIS community as a whole. We believe developing recommendations which lead to a decision, is one of the roles of the Council.

In our interviews with GIS participants, we were told of long standing issues that were viewed as not being resolved. We noted these issues were frequently discussed at Council or working group meetings. What seemed to be missing was the step that concluded with a Council position. The Council did not clearly communicate consensus on the issue, provide a formal resolution to the GIS community at large, or make a recommendation to the governor or legislature if warranted.

In GIS development, just as for development of any management tool, issues arise which if not resolved, cause duplication of effort and process inefficiencies. From interviews and observations, we prepared a list of topics described as issues requiring resolution. We narrowed our list to three categories:

< Potential legal issues.

<   NRIS roles and responsibilities.
<   Council and Technical Group roles.

In the following sections, we examine the three categories in more detail.

Discussion of Legal Issues has not Resulted in a Council Position

Interviewees described potential legal issues warranting review and recommendation by the Council. These include:

<   Digitized certificates of survey. Users questioned whether digitized documentation meets the intent of current law regarding survey requirements.

<   GIS data accuracy. Users are concerned entities developing or providing GIS data could be held liable for inaccuracies.

<   Privacy. Users are concerned about access to individual names and addresses through GIS data sets and the potential for developing mailing lists.

<   Access fees. Some users are concerned about whether charging fees for access to GIS data was appropriate.

<   Data access. Users are concerned some entities were not allowing access to GIS data, which should be considered public information.

We noted considerable discussion of these topics by the Council and various working groups. However, meeting minutes did not identify resolutions or formal positions reflecting Council consensus. We believe a formal Council position in these areas is important. To protect the investment in time and money regarding the establishment of GIS capabilities, it is important to resolve issues as early in the development process as possible. Council positions should consider how potential legal issues are affected by developing GIS capabilities within the framework of existing law and address inconsistencies in interpretations between GIS participants.

Roles and Responsibilities of NRIS

We examined NRIS roles and responsibilities such as: clearinghouse, custodianship for some natural resources information, providing access to GIS equipment (hardware/software), GIS training, agency

project assistance, and data access assistance. Discussions with state agency and local government officials also indicated confusion about the extent and limits of NRIS responsibilities. We recorded questions such as the following:

< If NRIS is the state clearinghouse, will or should all state agency data ultimately reside there?

< If NRIS provides limited GIS training for the public and local governments, why not expand the capability to include training for state agency staff?

< If NRIS provides GIS project services for some state agencies, why not centralize GIS support activity and require more agencies to use this capability?

< Is NRIS only responsible for natural resource data?

< Can NRIS assume custodianship for data sets/layers outside of the natural resource area?

The relationship between NRIS and other state agencies is unique. NRIS was initially created to provide specific natural resource data services to state agencies, the public, and other government entities. The fundamental NRIS roles and responsibilities are established by Montana law. However, additional NRIS roles and responsibilities that can impact other agencies should be clearly stated. Interviewees expressed concern about NRIS roles and responsibilities which are not clearly defined or identified because there is potential for duplication of effort, increasing project cost and decreasing the effectiveness of government entities when confusion about roles and responsibilities exists.

Roles and Responsibilities Topic is Broad

After discussions with members of the four coordinating groups, we determined the designation of roles and responsibilities is a broader topic than just NRIS. For example, the defined roles of organizations such as the DofA's Information Services Division and Department of Commerce's Census and Economic Information Center also influence GIS activities and priorities of other government entities. We believe recommendations regarding

variation or clarification of roles and responsibilities are within the intent of the Council executive order. If the Council determines one role versus another better serves state government and/or the GIS community at large, then a formal Council recommendation is appropriate.

Council and Technical Group Roles

We compared the role of the Council to the Technical Group by examining the duties and responsibilities identified in the Council executive order and the Technical Group memorandum of understanding. In addition, we considered comments from interviewees across the GIS community. Both documents reflect responsibilities for coordination and cooperation, which were positively supported by interviewees. We believe it is acceptable to establish overlapping roles for coordination and cooperation. We previously concluded cooperation is the primary reason for GIS success in Montana to date.

However, both documents identify responsibilities for establishing priorities, assuring cost sharing, and standardization. We believe overlap in these three areas could be the basis for some of the concerns expressed by interviewees. For the most active participants, dual responsibility does not create a problem. For less active or potential new participants this can lead to confusion. Again, a more formal resolution is needed when confusion about missions or roles impacts other entities. Council recommendations are appropriate in this circumstance.

Pro-Active Management is Needed

We believe the Council should assume a more pro-active role regarding resolution of issues such as the three categories identified in the previous sections. GIS development is a process of technological innovation providing opportunities for growth and change and requires active management.

Issue-Oriented Model

We examined the process established by the Council to review and resolve issues. The Council selected a process known as the "issue oriented model", which allows an issue to be brought to their attention essentially by anyone in the GIS community. Typically, an

issue would be assigned to one of the Council's working groups for development of a recommendation.

In our review of meeting minutes, we identified issues assigned to working groups. We also noted working group discussions about the issues. In many cases, we noted the topic was later discussed by the Council. However, in very few instances could we determine the Council position or a final consensus. Even in those cases where the Council apparently decided not to pursue an issue farther, this position was not clear.

We believe a more active management approach would revitalize the issue-oriented model by:

< Setting milestones, because participants need to know when to expect resolution.

< Formalizing the resolution by documenting the decision.

< Developing recommendations for the governor and/or legislature as necessary.

At one extreme, Council proposals for resolution may be no more than a policy statement reflecting consensus. At the other extreme, the Council could make a recommendation to the governor or the legislature to revise existing state law. However, for the GIS community, we believe the most important step to resolution is formalizing the Council's position. From there, the Council can determine whether additional steps are appropriate.

<div style="border:1px solid black; padding:10px;">

__Recommendation #2__
We recommend the Council develop procedures for resolving issues within the GIS community by:

A. **Establishing clear milestones and deadlines.**

B. **Documenting council consensus or resolution.**

C. **Developing formal recommendations for the governor and/or legislature, if necessary.**

</div>

Administrative Support

The executive order assigns the responsibility of providing administrative support for the Council to the DofA. The department established a half-time GIS coordinator position to provide direct support to the Council and serve as the state GIS coordinator. In addition, another DofA staff member provides GIS information technology support to state agencies. Previously in the report, we made recommendations for the Council to increase planning efforts and more actively manage and resolve issues of concern to the GIS community. More emphasis in both of these areas will require additional administrative support for the Council.

Current Resources are a Limiting Factor

Council members have limited time to dedicate to GIS activities because of their primary department, program, or business responsibilities. The Council relies on the part-time coordinator to assist the chair and members with meeting agendas and minutes. Depending on availability of the coordinator, we noted Council members routinely assisted with meeting and agenda preparation. Routinely, the coordinator may be involved with federal agencies and national organizations representing Montana. In addition, the coordinator works with other state GIS groups to organize meetings and help prepare grant/funding justification.

To date, implementation of GIS across Montana has been successful because of the willingness of active participants to dedicate time and energy to Council business. In many instances this required members to place GIS activities above their primary duties and

responsibilities. For the Council to implement our recommendations and become a more effective project and state GIS advocate, it needs help to review project status and conduct thorough planning reviews. Similarly, in order to more actively resolve issues impacting GIS development, the Council will require help to identify priorities, document progress, and formalize positions.

The land parcel project provides a good example of the impact of dedicated resources. This project is nearing initial completion and we identified specific features contributing to its success:

< A project officer was selected early in the development process.

< The project officer prepared a formal planning document.

< Funding requirements were identified early in the planning phase.

< Requests for funding were processed through state, federal and local agencies and private sector organizations.

< Council and other coordinating groups were involved in planning, reviewing milestones, and resolution of issues.

Additional Resources

To assure Council members are aware of project status and issue priorities, the primary need appears to be additional administrative support. This requires tracking planning documentation, monitoring working group deliberations, recording meeting activities, and formalizing consensus/resolution. To some degree, this kind of support may be needed for all eleven framework layers. In addition, coordinating development of major data sets between entities could become a significant workload. The Council could also examine the need for an overall state implementation plan similar to those developed by other states. Further, the Council could consider preparing an annual assessment report for the governor and legislature to provide an overall status of planning and progress, identify funding requirements/priorities, or request assistance in resolving issues. Without additional resources, it is unlikely the Council could undertake these kinds of efforts.

There are alternatives for increasing the resources to support the needs of GIS development in Montana. The most direct approach would be to increase the resources available to the Council. Resources could consist of funding or staff from a single department or from several departments within state government. Joint support could be provided through financial and/or staff resource contributions of multiple state agencies. There are also options for assignment of the coordinator function. The Governor's Office, Department of Administration, and the Montana State Library should all be considered. Another approach might be to separate specific responsibilities. For example, support for Council planning review could be designated to one agency while support for meeting agendas and minutes could be designated to another.

Council Recommendation Needed

We believe identification of the requirement for resources to meet the needs of the Council and statewide GIS coordinator activities is a Council responsibility. The governor's executive order establishes the importance of coordinating efforts at all levels in order to minimize duplication and take advantage of cost sharing. More importantly, the order prioritizes the role of GIS in future decision-making for both the public and private sector. While the order endorses an "aggressive policy", the level of aggressiveness is clearly left to the Council to determine. We believe the Council should consider the resources issue and develop a specific recommendation for the Governor.

Recommendation #3
We recommend the Council:

A. **Determine the amount of administrative support required to improve planning, resolve issues, and provide an overall GIS implementation status.**

B. **Evaluate alternatives for resource allocation.**

C. **Prepare a recommendation to the Governor addressing resource allocation.**

JUDY MARTZ
GOVERNOR

ROOM 229, MITCHELL BUILDING
125 N ROBERTS

STATE OF MONTANA

(406) 444-2700
FAX: (406) 444-2701

PO BOX 200113
HELENA, MONTANA 59620-0113

August 17, 2001

Scott A. Seacat, Legislative Auditor
Legislative Audit Division
State Capitol
Helena, MT 59620

Dear Mr. Seacat:

The Montana Geographic Information Council (MGIC) has reviewed the recommendations pertaining to the Geographic Information System (GIS) Implementation and Development Performance Audit of various federal, state, local and private sector entities. In a recent planning session of MGIC, it considered your report, and offers the following response.

RECOMMENDATION #1: WE RECOMMEND THE COUNCIL ESTABLISH A FRAMEWORK LAYER PROJECT PLANNING REVIEW PROCESS, TO INCLUDE REVIEW OF:
- COST, FUNDING SOURCES, AND MILESTONES.
- ENTITY PARTICIPATION AND TRAINING NEEDS.
- DATA CUSTODIANSHIP.
- STANDARDIZATION REQUIREMENTS.

Response: MGIC concurs with the recommendations. MGIC does point out that its role in framework project planning is oversight, policy and direction, and that it is not funded to provide the actual work that will be needed. At this time, MGIC must rely on volunteer efforts to develop plans for individual framework layers, and agencies or entities developing these plans are not statutorily responsible to MGIC.

MGIC discussed this issue at length during its August 9, 2001 meeting, and will continue to develop a more formal review process. MGIC believes that existing efforts to develop a Montana Spatial Data Infrastructure Strategic Plan must be encouraged. Furthermore, MGIC points out that additional staff and coordination resources (see recommendation #3) may be needed to effectively accomplish these recommendations.

Scott A. Seacat
Page 2
August 17, 2001

RECOMMEDATION #2: WE RECOMMEND THE COUNCIL DEVELOP PROCEDURES FOR RESOLVING ISSUES WITHIN THE GIS COMMUNITY BY:
- ESTABLISHING CLEAR MILESTONES AND DEADLINES.
- DOCUMENTING COUNCIL CONSENSUS OR RESOLUTION
- DEVELOPING FORMAL RECOMMENDATIONS FOR THE GOVERNOR AND/OR LEGISLATURE, IF NECESSARY.

Response: MGIC concurs with the recommendations. MGIC is in the process of modifying it's operating procedures to address this recommendation, which should be completed before December 31, 2001.

RECOMMENDATION #3: WE RECOMMEND THE COUNCIL:
- DETERMINE THE AMOUNT OF ADMINISTRATIVE SUPPORT REQUIRED TO IMPORVE PLANNING, RESOLVE ISSUES, AND PROVIDE AN OVERALL GIS IMPLEMENTATION STATUS
- EVALUATE ALTERNATIVES FOR SESOURCE ALLOCATION
- PREPARE A COMMENDATION TO THE GOVERNOR ADDRESSING RESOURCE ALLOCATION

Response: MGIC concurs with the recommendations. MGIC staff will develop a report on existing staff roles and responsibilities related to Council, along with alternatives and options for expanding services to better address areas of shortfall noted in the body of the audit report. This report will be discussed at future council meetings, and could result in requests for additional council support from participating entities.

We appreciate the opportunity to work with your staff on these issues.

Sincerely,

Tony Herbert
Acting Chair, Montana Geographic Information Council
Deputy CIO, ITSD, MT Department of Administration